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Integrating Nuclear Information to Enhance Safeguards

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Integrating Nuclear Information to Enhance Safeguards

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Abstract

Implementation of the Strengthened Safeguards System provides many new opportunities and challenges for collecting, analyzing and archiving nuclear materials safeguards information. For the first time in the history of safeguards, the International Atomic Energy Agency will be required not only to verify the accuracy of declarations, but also the completeness. To successfully implement the new safeguards regime, new and innovative ways of collecting, analyzing and archiving large amounts of safeguards information will be required. A conceptual system design that utilizes a geographical information system for the integration and analysis of this safeguards information will be described and demonstrated.

Introduction

The proliferation of nuclear weapons is one of the most serious issues confronting global security since the end of the Cold War. Currently, 68 nations have declared significant nuclear activities, including plutonium separation, plutonium fuel manufacturing, plutonium- and highly enriched uranium-fueled reactors, and uranium enrichment. The Department of Energy's International Safeguards Division leads national and international efforts to support the prevention of the spread of nuclear weapons materials, technology, and expertise; the detection of nuclear proliferation worldwide; the reversal of nuclear weapons proliferation; and response to suspected nuclear proliferation activities.

One of the important ways to protect against the proliferation of nuclear weapons is by tracking nuclear materials and activities in international commerce. Immediate access to nuclear information is a necessary part of assuring the secure and transparent use of nuclear materials. Recognizing the need for an enhanced capability for tracking and analysis of nuclear materials and information worldwide, DOE implemented the Integrated Nuclear Information Program (INIP) in April 1998. Although this program was not specifically created to enhance safeguards, the framework established for storage, retrieval and analysis of nuclear information could support the IAEA's implementation of the Additional Protocol.

Background

Approval of the Additional Protocol (AP) in 1997 was the most significant revision of IAEA safeguards since the adoption of comprehensive safeguards in the 1970s. The AP provided for additional measures to supplement INFCIRC153 safeguards, such as: expanded declarations to include nuclear related manufacturing, research and development; complimentary access to assure the absence of undeclared nuclear material and activities; and implementation of new and expanded techniques such as environmental sampling and modern communication and data transmission for remote and unattended monitoring systems. One of the challenges to successful implementation of the AP is providing a mechanism for integration, organization, archiving and retrieval of large amounts of data from disparate sources.

Design Concept

Figure 1 is a graphic depiction of the design concept described in this paper. The utilization of a common user interface to provide rapid access to a diverse data set by a large number of users is key to the design concept. This shared infrastructure will establish standards and protocols for communication between

various database components and "users" of the system. It is also necessary to provide a means of access control and authentication. Data will be submitted and retrieved utilizing the Internet through a web-browser interface. Some of the key benefits of this approach are:

- *Rapid access to a vast amount of nuclear information via a web-browser interface*
- *Improved efficiency and timeliness in maintaining up to date analysis and reporting of nuclear activities*
- *Improved integration & comparison of data from different sources*
- *Secure, controlled electronic communication via a common infrastructure*

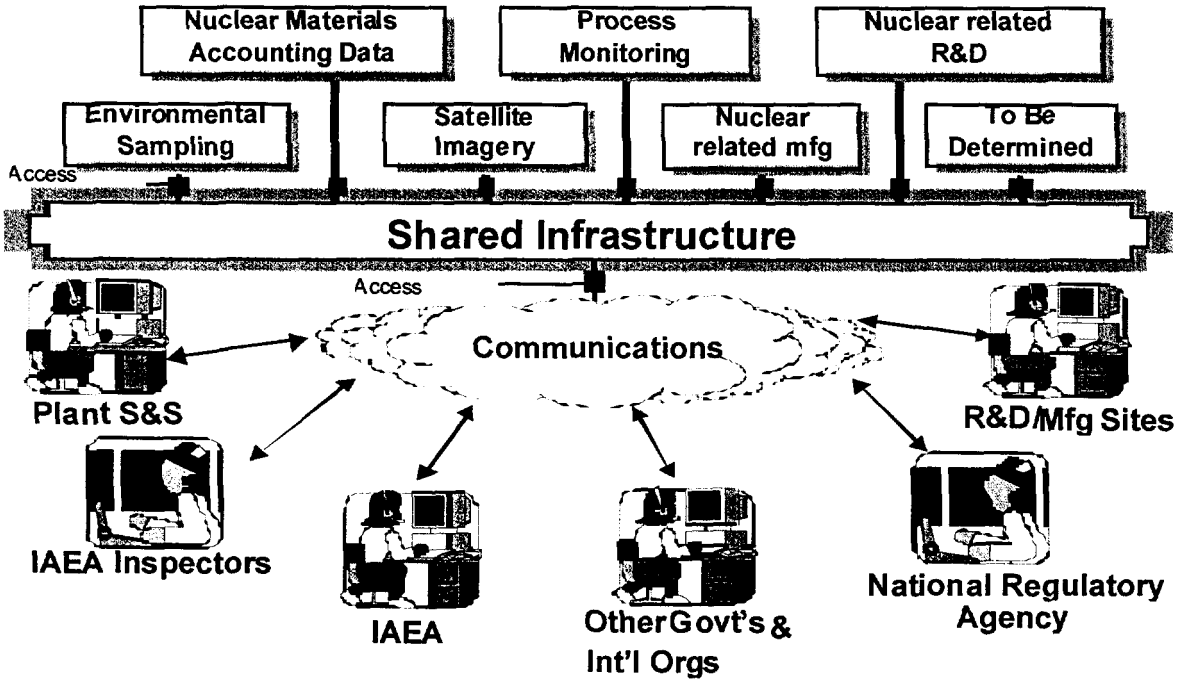
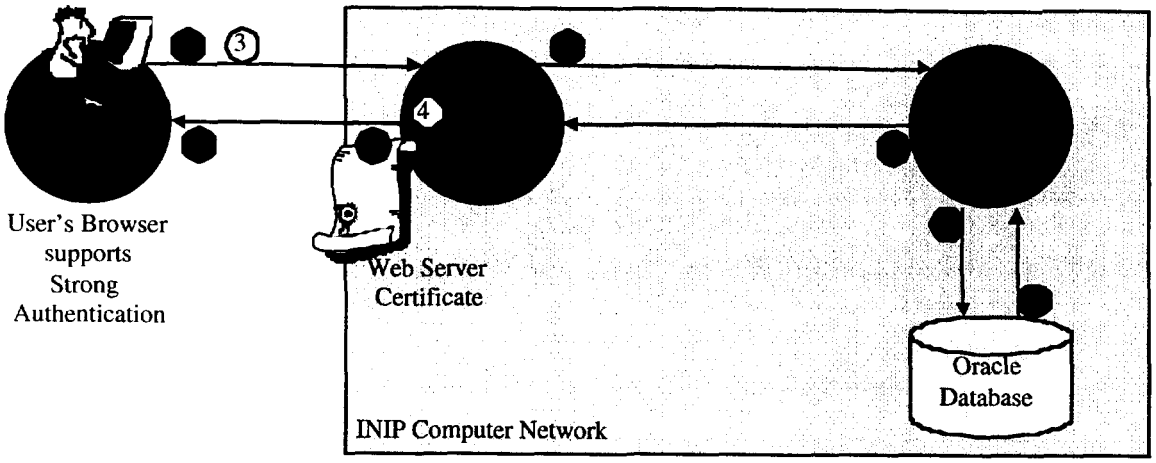


Figure 1. Design Concept



User Authentication and Access Control

- User connects to INIP Web Server
- INIP Web Server uses certificate to authenticate itself to user, and requests username and password
- (3) User types in username and password. Browser transmits them (encrypted) to INIP Web Server
- (4) INIP Web Server authenticates user based on username and password provided. Authorized user receives access to specific data

Data Preparation and Transfer

- INIP Web server communicates with INIP Software to request display of information
- INIP Software requests needed data from database
- Oracle database returns requested data to INIP Software
- INIP Software prepares and formats data for transmission
- INIP Web Server sends encrypted web page to User's Browser

Figure 2. System Architecture

System Architecture

The system architecture is depicted in Figure 2. User access is controlled through password protection and digital authentication. Interface software requests data from ORACLE database. Data is encrypted in transmission. A virtual private database provides fine-grained control and application context. Access can be controlled based on user privileges and application being used. ORACLE applications are employed to assure that users can only see data to which they are authorized access. Data access is managed at the database level.

Information contained in the database that can be access through a secure web server may include:

- Inventory estimates (quantity, form, location)
- Facility design and operation, including security
- Facility and site diagrams
- Geographical Coordinates
- Inspection reports
- Material flow and transportation routes
- Photos and satellite imagery

The web pages are organized in layers. Each layer contains more detailed fuel cycle information. The top layer (see Figure 3) provides access to a brief fuel cycle tutorial, a world map highlighting regions and countries, and a summary level nuclear material inventory. The second layer is the region layer, which enables the user to enter information or view information pertaining to the material flow and interaction in a specific geographical region (Figure 4). The next layer is the country layer (Figure 5) which provides a country map with GPS

coordinates for facilities, design specifications, and material inventories sorted by form. The bottom layer is the site layer, which provides site specific layouts, photos, satellite imagery (if available), inspection data, import/export information, and other relevant information pertaining to the site. At the site level it is possible to access detailed material flow and process flow diagrams.

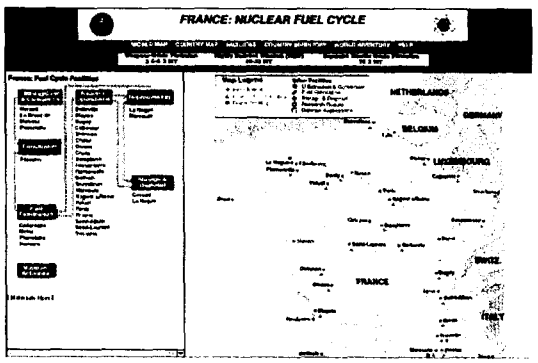


Figure 3.

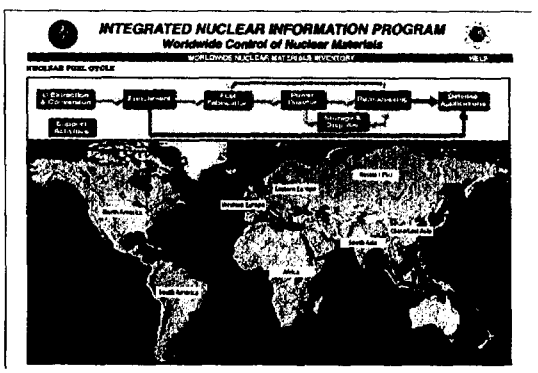


Figure 4.

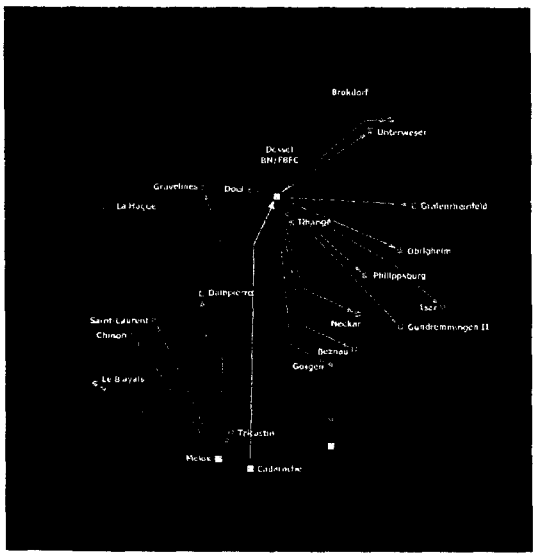


Figure 5.

Conclusion

The continued development of nuclear energy is important to achieving a sustainable global energy supply. The degree to which nuclear energy will be able to provide future energy needs will depend in part on the perceived effectiveness of safeguards and the degree to transparency in the nuclear fuel cycle. Full implementation of the Additional Protocol and the integration of these additional measures with traditional safeguards can be greatly enhanced by utilizing the technologies such as those presented here. It is possible to conceive of a future where safeguards information and remote monitoring data can be transmitted or accessed by any member state through a secure Internet connection. Utilization of Internet and database applications for the archival and updating of safeguards information can provide the IAEA with a cost-effective method to assure the correctness and completeness of State declarations.